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SPECIFICATIONS FOR DRONE/RPV INSTRUMENTATION AT THE HILL/WENDOVER DUGWAY RANGES

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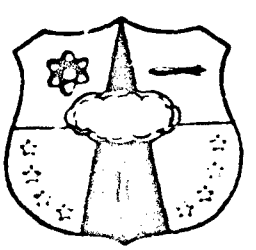
February 1976

Final Report



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AIR FORCE SPECIAL WEAPONS CENTER
Air Force Systems Command
Kirtland Air Force Base, NM 87117

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As this work was in progress, the Continental Operations Range (COR) was denied funding by the Congress and was therefore cancelled.

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This report has been reviewed by the Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

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Drone/RPV
Range Instrumentation
Continental Operations Range (COR)
Multilateration TSPI System
HAMOTS (High Accuracy Multiple Object Tracking System)

(20) ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report evaluates the compatibility of a proposed HAMOTS (High Activity Multiple Object Tracking System) for a multiple drone/RPV test range in the Hill/Wendover/Dugway area with the proposed mid-term Continental Operations Range (COR). The following documentation was reviewed: (1) Position Location/Display System Specification, (2) System Software Specifications, (3) Timing Network Specifications, (4) Pointing Data Network Specifications, (5) Facilities Requirements, (6) Activation Plan. (OVER)

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ABSTRACT (Cont'd)

Under the premise that this system is implemented prior to initiation of Mid-Term COR development in the Hill/Wendover/Dugway area, there is nothing that has been found in these specifications that would represent a major stumbling block to utilization of the system as part of Mid-Term COR in that area. The HAMOTS with its computer displays and software, along with the telemetry system and the pointing data system should be viewed as a single instrumentation system for purposes of Mid-Term COR planning.

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SECTION I

INTRODUCTION

The General Dynamics Engineering Services Contract with Air Force Flight Test Center provided engineering design services to define system/equipment specifications, operational/maintenance design concepts, implementation planning and cost analysis for a multiple Drone/RPV test range capability in the Hill/Wendover/Dugway (H/W/D) complex. A contract end item was the following set of plans and specifications:

1. Position Location/Display System Specifications
2. System Software Specifications
3. Timing Network Specifications
4. Pointing Data Network Specifications
5. Facilities Requirements
6. Activation Plan

These CDRL items have been reviewed with respect to their compatibility with COR Mid-Term planning. This report presents the findings of the review.

The first portion of this report will discuss COR utilization of the Hill/Wendover/Dugway complex during the Mid-Term phase and the COR plans for instrumentation, test range improvements, and integration of the Hill/Wendover/Dugway complex with COR. This discussion will serve as the basis for evaluating the compatibility of the General Dynamics specifications and activation plans with COR Mid-Term planning.

The latter portion of this report will deal specifically with evaluation of the compatibility of the General Dynamics plans and specifications

with Mid-Term COR. The General Dynamics CDRL items cited above have been presented to TESPO by AFFTC as representative of their requirements for a COR range to support Drone/RPV testing in the future. The AFFTC Range Improvement Plan for the Hill/Wendover and Dugway complex in support of multiple Drone/RPV testing may be implemented in whole or in part by funding separate from COR prior to initiation of the COR Mid-Term phase. If the separate funding is not made available, the plan may be implemented with Mid-Term COR funding. The questions of compatibility with COR will depend upon the manner in which the Drone/RPV Range Improvements are implemented.

SECTION II

GROUND RULES FOR THE EVALUATION

The question of compatibility of the General Dynamics specifications with Mid-Term COR planning depends upon the time scale of their implementation and the source of funding for that implementation. There are two basic assumptions that may be made for improvement of the Drone/RPV test range at H/W/D. The first assumption is that implementation, in whole or in part, of the AFFTC Instrumentation Plan per the General Dynamics specifications will be achieved by AFFTC prior to Mid-Term COR with funds other than COR funds. The second assumption is that implementation will be done by TESPO during the COR Mid-Term phase.

If the H/W/D range improvements for Drone/RPV testing are to be included in the COR Mid-Term plan and funded by COR, funding will not be available until June 1977. In the interim, the AFFTC requirements must be merged with those of other range users and the required H/W/D range improvements engineered on a design-to-budget basis. If, on the other hand, interim range improvements are separately funded and implemented by AFFTC prior to June 1977, the Mid-Term COR design must attempt to utilize the resulting equipments and facilities to the maximum extent possible.

COR funded improvements to the H/W/D complex must be evaluated in terms of not only Drone/RPV test support requirements, but also the test support requirements of all present and future H/W/D range users (AFLC, ANG, TAC, SAC, MAC, etc.), and the required improvements must be made within the overall COR budget. The General Dynamics specifications only address a subset of these requirements.

In addition to the range instrumentation, communication, data processing and display systems specified by the General Dynamics documentation, additional threat simulation systems, ground target systems, ground scoring systems, expanded range timing, calibration and communication systems will be installed during the Mid-Term development phase. Associated with the additional systems required by COR will be a requirement for a larger data processing and display capability than provided by the General Dynamics specifications. For this reason, the Range Instrumentation System specified by General Dynamics will not be implemented in the fashion specified if improved Drone/RPV test instrumentation requirements are to be satisfied by Mid-Term COR.

The question of compatibility of the Instrumentation Systems specified by General Dynamics with the proposed Mid-Term COR only has significance if the AFFTC Instrumentation Plan is independently implemented. Therefore, the following evaluation of these specifications assumes that the AFFTC plan is implemented in its entirety prior to initiation of Mid-Term COR range improvements and that the intent of the evaluation is to flag potential problems in utilization of the resulting equipments by COR in order that incompatibilities may be corrected prior to construction of the General Dynamics range design.

SECTION III

GENERAL CONCLUSIONS

The General Dynamics CDRL items deal specifically with a multilateration TSPI system to cover the entire H/W/D range and a data processing and display system at Hill AFB to process, record, and display the TSPI data along with telemetry data from GFE telemetry systems. The specifications also cover a precision range timing system and a pointing data system for providing compatible pointing data to other range instrumentation. Range and Mission Control facilities at Hill AFB along with key field facilities are specified. An Activation Plan for implementation of the specified instrumentation system is also supplied.

Though the specifications define the voice and data communications requirements of the instrumentation system, General Dynamics has not provided a specification for an inter-range communications network. This is being done separately through a joint AFLC/AFSC CEIP. Also, There are no provisions for computer aided monitoring and control of aircraft that are not equipped with HAMOTS (High Accuracy Multiple Object Tracking System) transponders. Though an interface with SLC/ATC is specified, no software for processing or displaying this data is specified.

Other characteristics and limitations of the specified system as they relate to Mid-Term COR requirements are discussed in Section 5 of this report.

The basic conclusion derived from this evaluation is that there would be no major impediment to full utilization of the specified equipment and facilities by COR should the system be implemented

prior to initiation of COR development in the H/W/D area. The HAMOTS system specified would satisfy the COR TSPI requirements provided software modifications were made to provide for operation with airborne instrumentation pods. With little modification, the specified timing system would meet COR requirements. The pointing data system would probably require more extensive modification to satisfy COR requirements, but the anticipated modifications are straightforward. The specified DAPAC computer will not handle the anticipated Mid-Term COR data processing requirements. For COR planning purposes, the HAMOTS, its data processing system and its associated interfaces with telemetry and other range instrumentation should be considered as a single, self-contained unit which would interface with COR via a direct link with the specified DAPAC computer. The Range/Mission Control Center display consoles would not be used by COR since command and control for COR will be centered in COR Central at Nellis AFB. The specified R/MCC display and control system would be retained for local range management and mission control when the range complex is not being utilized by COR.

SECTION IV

INTEGRATION OF THE H/W/D COMPLEX INTO COR

COR planning is based upon DCP #111 (ref. 1) and is further elaborated in the AFCOR Development Plan 73-1 (ref. 2). DCP #111 calls for integration of the Hill/Wendover and Dugway complex into COR during the Mid-Term phase (July 1977 to June 1979). At this time, the H/W/D complex must be integrated with the COR complex developed during the Near-Term phase as defined in the COR Program Management Plan (PMP) and its associated annexes (ref. 3). Therefore, in defining COR Development Plans for the Mid-Term phase as they pertain to H/W/D, DCP #111 will be taken as the guiding document; in addition, the COR configuration with which the H/W/D range complex must interface will be taken as the Near-Term COR FOC configuration as defined in the COR PMP.

The existing operations on the Hill/Wendover and Dugway complex including the Drone/RPV testing are briefly described in reference 4 along with projected range workload exclusive of COR testing requirements. The existing Drone/RPV test activities along with projected future test requirements are given in reference 3. Planning for extension of COR to the Hill/Wendover and Dugway area must accommodate and support expansion of these activities.

In addition to the above, COR Mid-Term planning must provide for support of test operations similar to those to be accommodated on the Nellis complex. This will involve improvements to radar surveillance in the Hill/Wendover and Dugway area and in the corridor between the H/W/D complex and the Nellis complex, improvements to TSPI coverage in the H/W/D complex, installation of a

threat simulation complex and associated communications in support of Electronic Warfare testing, improvements to the target complexes including the addition of hardened threat emitters and mobile targets. Associated with the added threat environment and target complexes will be addition of ground based scoring systems, including an automatic bomb scoring capability. These additions to the range will result in increased communication requirements and increased data processing requirements at Hill AFB. Adding also to the data processing requirement will be the requirement for transmission of real-time data for display and mission control to COR Central at Nellis via the COR microwave backbone system.

COR design is predicated on a set of basic guidelines. The same guidelines will determine the direction of COR development in the Hill/Wendover and Dugway area. These guidelines are:

1. Low-cost operation. This includes maximum use of existing range assets and unmanned operation of field equipments where practicable.
2. Maximum combat realism within funding constraints.
3. Rapid and accurate data reduction and reporting. This includes real-time data reduction and display for mission control and safety monitoring and control purposes.
4. Maximum range flexibility and equipment mobility.
5. Minimum modification to operational equipment.
6. Capability for large-scale strike-size test and training missions.

These guidelines have played a key role in the drafting of the Systems Specifications and System Segment Specifications for the Near-Term COR configuration (reference 6).

Specific requirements emanating from these guidelines may be summarized as follows:

1. Key factor in guideline one is minimizing cost of operation through minimization of the manning requirements for the threat simulator systems, the scoring systems, the target systems, and the range instrumentation systems that are deployed in the field. This has manifested itself in concentration of all command and control functions for Red Forces, White Forces, and Blue Forces within COR Central at Nellis AFB.

2. The second guideline is central to the COR concept. Combat realism requires a sophisticated threat environment be deployed at the Hill/Wendover/Dugway area and that the threat simulators deployed in this area be tied into a simulated Red command and control network located in COR Central at Nellis AFB. The basic threat configuration to be installed at Hill/Wendover/Dugway is given in Table 1. The COR concept calls for inclusion of EW and ground-to-air scoring capability as part of the threat simulator complex.

Table 1

PROPOSED H/W/D THREAT ENVIRONMENT

Surveillance:	WEST VA TALL KING
Height Finders:	SIDE NET THIN SKIN
Acquisition:	AN/MSQ-T7 AN/MSQ-T8 AN/MSQ-T11 BACK NET
SAM (Fire Control):	AN/MPS-T1 AN/MPS-TY AN/MSQ-T13 SA-7 (two) AN/MPS-T3 Advanced System
AAA (Fire Control):	AN/MPS-9 AN/MSQ-T12 FLAP WHEEL
Emitters:	AN/MSQ-T3 AN/MSQ-T4 AN/MSQ-T5 AN/MSQ-T6
Ground Based Jammers:	

3. The third guideline has led to formulation of specific data system requirements for Near-Term COR. These data requirements must be taken into account in assuring Mid-Term compatibility between the Hill/Wendover/Dugway complex and the Nellis complex. The Near-Term instrumentation desired characteristics, data accuracy requirements and transmitted data resolution requirements are summarized in Table 2 (the accuracy goals for Mid-Term COR are shown in parantheses). Key considerations in scoring of air-to-air operations, air-to-ground operations, and Electronic Warfare operations are summarized in Table 3. Prime considerations in correlation of data taken by diverse sensors throughout the range complex are the accurate time tagging of the data at the sensors and the use of geocentric coordinate system for transfer of data to and from COR Central.

4. The fourth guideline is tied to the question of combat realism. To assure a realistic threat environment, the threat environment must possess the capability for rapid re-deployment. This will result in the need for a TSPI system and a communication system that can be repidly reoriented or redeployed to match the rapid reconfiguration of the threat. A critical consideration in this aspect of the COR design is the requirement for encription of sensitive threat environment and instrumentation data.

5. The fifth guideline represents a significant constraint on the data that can be acquired from the aircraft participating in COR operations. Certain of this data are critical to the COR data gathering operation. Table 4 contains a list of aircraft data that will be required by COR. It is currently planned to use a self-contained, pod mounted instrumentation package on these aircraft for the purpose of gathering this data. The TSPI system at H/W/D must be capable of receiving the telemetered data from instrumentation pods.

6. The sixth guideline is also a key aspect of the COR concept. That is that large scale testing or many-on-many interactive tests be achievable. This results in a requirement for a multiple target TSPI tracking capability that will accommodate a large number of aircraft and ground-based elements.

Also required are the facilities to support Blue Force command and control. Further details on COR requirements may be found in references 3 and 6.

Table 2

DESIRABLE RANGE DATA (INSTRUMENTATION) CHARACTERISTICS

	ALT (Ft AGL MSL)	POSITION (One Sigma) (Ft)	VELOCITY VECTORS (FPS)	(Degrees)	ATTITUDE (Degrees)	AIRCRAFT ACCELERATION ACCURACY (g)	SAMPLE RATE	AIRSPACE COVERAGE (N. Mi.)	NUMBER OF SIMULTANEOUS PARTICIPANTS		RESOLUTION OF TIME, POSITION, VELOCITY, ACCELERATION (TPVA) TRANSMITTED DATA
									High Activity	Low Activity	
AIR-TO-AIR											
General Maneuvering	5K-30K (100-100K)	25' (25')	25 (25)	--	--	0.5 (0.5)		40 dia.	8	12	Time: 1 millisecond (millisec, time mark accurate to 1 msec.)
Ballistic Weapons Programs	5K-30K (0.5-40K)	10' (5')	5 (5)	0.5 (.3)	0.5[1] (.1)	--		16 x 25	4	--	Position: 1 foot
Missile Programs	5K-30K (0.5-40K)	25' (10')	-- (5)	-- (.3)	1.0 (.3)	--		30 x 70	4	--	Velocity: 0.5 ft/sec
											Acceleration: 0.5 ft/sec^2
AIR-TO-GROUND											
General Maneuvering	2K-40K (0.2-40K)	200' (50')	-- (25)	— —	— —	0.5 (0.5)		16 x 125	4	16	
Ballistic Weapons	2K-40K (0-40K)	100' (10')	5 2	2 (.5)	0.5[2] (.05)	--		3 dia.	4	--	
Self/Powered/ Glide	2K-15K (0-40K)	100' (30')	-- (5)	-- (.6)	1.0 (.3)	--		40 x 40	4	--	
RPV											
General Maneuvering	2K-75K (0.1-100K)	200' (100')	--	--	--	0.5 (0.5)		16 x 125	4	16	
E.W.											
General Maneuvering	2K-50K (0.2-50K)	200' (200')	-- --	-- --	-- --	0.5 (0.5)		40 dia.	4	16	
GROUND-TO-AIR											
SAM General Criteria	2K-35K (0.1-100K)	50' (10')	-- (5)	-- (.3)	1.0 (.3)	--	TO BE COMPATIBLE WITH ACCURACY REQUIREMENTS	Simulated	4	—	
AAA General Criteria	2K-20K (0.1-40K)	25' (10')	10 (5)	.5 (.3)	.5 (.1)	--			4	--	

1. Requires Airborne Scoring 2. Requires Ground Target Scoring (GOAL)

Table 3

SCORING CONSIDERATIONS

A. Air-to-Air Scoring

1. Simulated Weapons

   a. Envelope scoring of guided weapons by ground based TSPI. Attitude information from aircraft instrumentation required.

   b. Scoring of aimed weapons by airborne measurements.

2. Actual Weapons

   a. Non-cooperative tracking of missiles and rockets by airborne or ground based systems

   b. Scoring of aimed weapons by target borne systems.

B. Air-to-Ground Scoring

1. Simulated Weapons

   a. Envelope scoring of guided weapons by ground based TSPI. Attitude information from aircraft instrumentation required.

   . Scoring of aimed weapons by airborne measurements.

2. Actual Weapons

   a. Non-cooperative tracking of missiles, bombs, and rockets by airborne or ground based systems.

   b. Scoring systems deployed at or near ground targets.

C. Electronic Warfare Scoring

1. Surveillance Radars: Event data, jammer power level and spectrum, signal-to-noise.

2. Command and Control System: Digitized plot-tell data.

3. Communications System: Radio signal reporting codes denoting signal strength, interference, noise, propagation disturbance, frequency of fading, modulation quality, and depth and frequency of message repeats for each transmission of voice & TTY messages. Real-time log of digital error rates and keyset input to the data acquisition system.

4. Terminal Acquisition Radars: Video recording of operator displays. Real-time comparison of target track with external TSPI data.

5. Terminal Threat Scoring: On-site scoring evaluations with only results transmitted to CORC. Ground-to-air weapons simulations. Use of external terminal area TSPI data for miss-distance scoring.

Table 4

NEAR-TERM COR
AIRCRAFT PARAMETER MEASUREMENTS

AIRCRAFT PERFORMANCE CAPABILITY

Altitude	100' AGL to 100,000 MSL
Airspeed	0 to 3,000 fps
Normal Acceleration	-2.5 to 9.0G
Attitudes	0 to 360° in 3 axes
Roll Rate	0 to 360°/Sec
Weapons Release Range	1000' to 50,000' + from target
Relative Velocity	0 to 6,000 fps
Dive and Climb Angles	0 to 90°

REQUIRED AIRCRAFT PERFORMANCE DATA

A. Absolute Aircraft Position
B. Time/Space Position Derivatives
C. Aircraft Attitude
D. Separation Range Between Aircraft
E. Track Crossing Angles
F. Aspect Angles
G. Aircraft Climb or Dive Angles
H. Acceleration
I. Vector Miss Distances
J. Tracking Time History

SECTION V

EVALUATION OF THE GENERAL DYNAMICS CDRL ITEMS

1. GENERAL COMMENTS

The following paragraphs discuss the General Dynamics specifications with respect to projected Mid-Term COR range requirements as outlined in the preceding section. It is assumed for the purposes of this analysis that the AFFTC instrumentation plan will be implemented prior to initiation of Mid-Term COR development in the area. On the premise that the Drone/RPV test range system will be a part of "existing range assets" by the time the projected COR development in the area starts, the potential problems associated with integrating these assets with COR will be explored.

The general range configuration specified by these documents is represented by Figures 1 and 2. Figure 1 portrays the geographical area under consideration, and is overlaid with the inter-range wideband microwave link. Figure 2 portrays the major subsystem interfaces. The total complement of range facilities associated with Drone/RPV testing fall into three categories: (a) existing equipment which will continue to be used, (b) existing equipment which will be upgraded or replaced with newer equipment, and (c) equipment being added to the range. The category (a) equipment includes: (1) Microwave command guidance system (MCGS), (2) Optical and radar tracking systems, (3) Ancillary equipment (auxiliary power, etc.). The category (b) equipment includes: (1) Telemetry, (2) Integrated voice communications, (3) FLITEVISION, (4) Timing system, (5) Pointing data network. The category (c) equipment includes: (1) HAMOTS, (2) Microwave data and voice communication, (3) Gap filler radars. The General Dynamics specifications define specific requirements for only the timing system, pointing data network, and HAMOTS. In

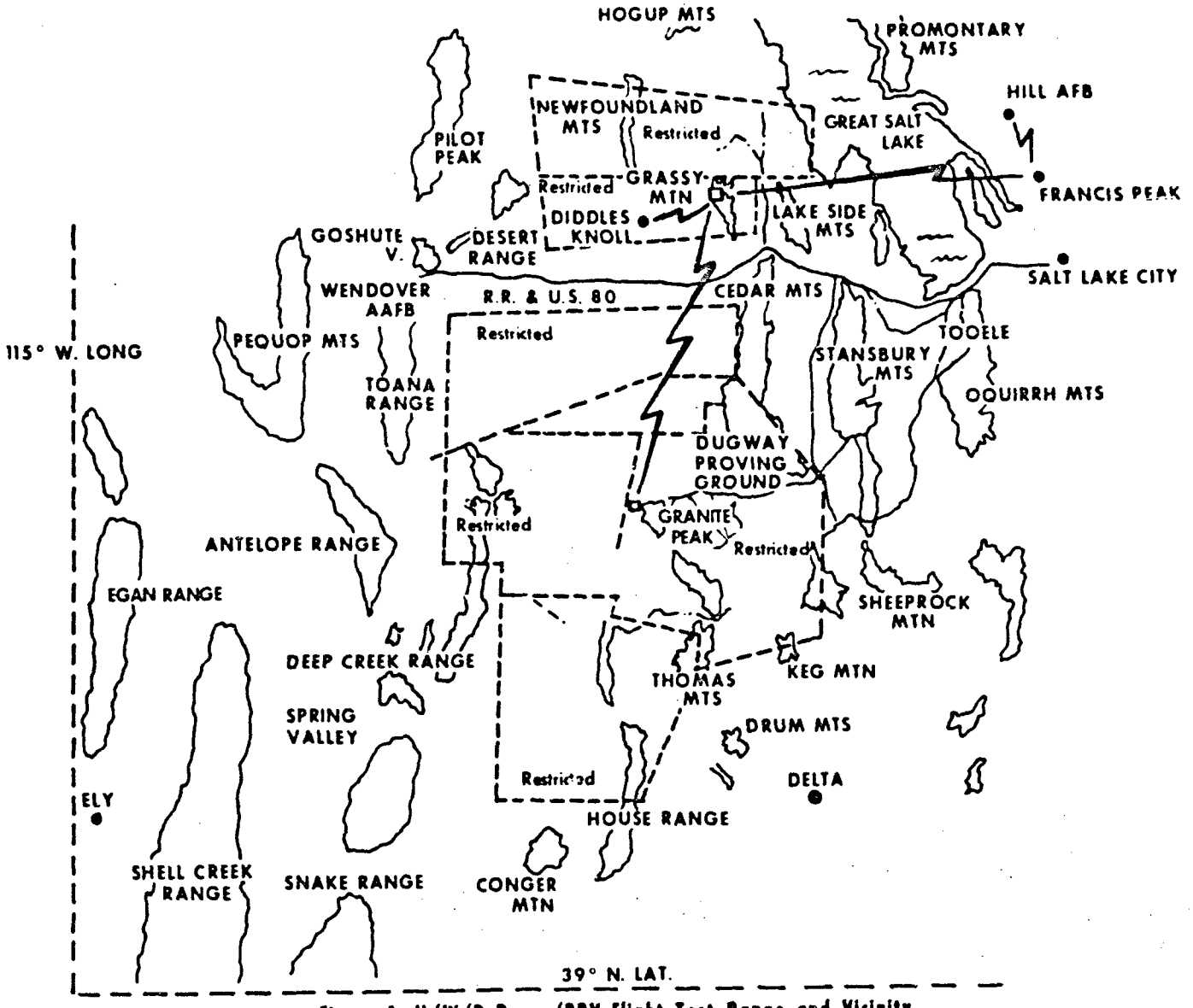

Figure 1. H/W/D Drone/RPV Flight Test Range and Vicinity

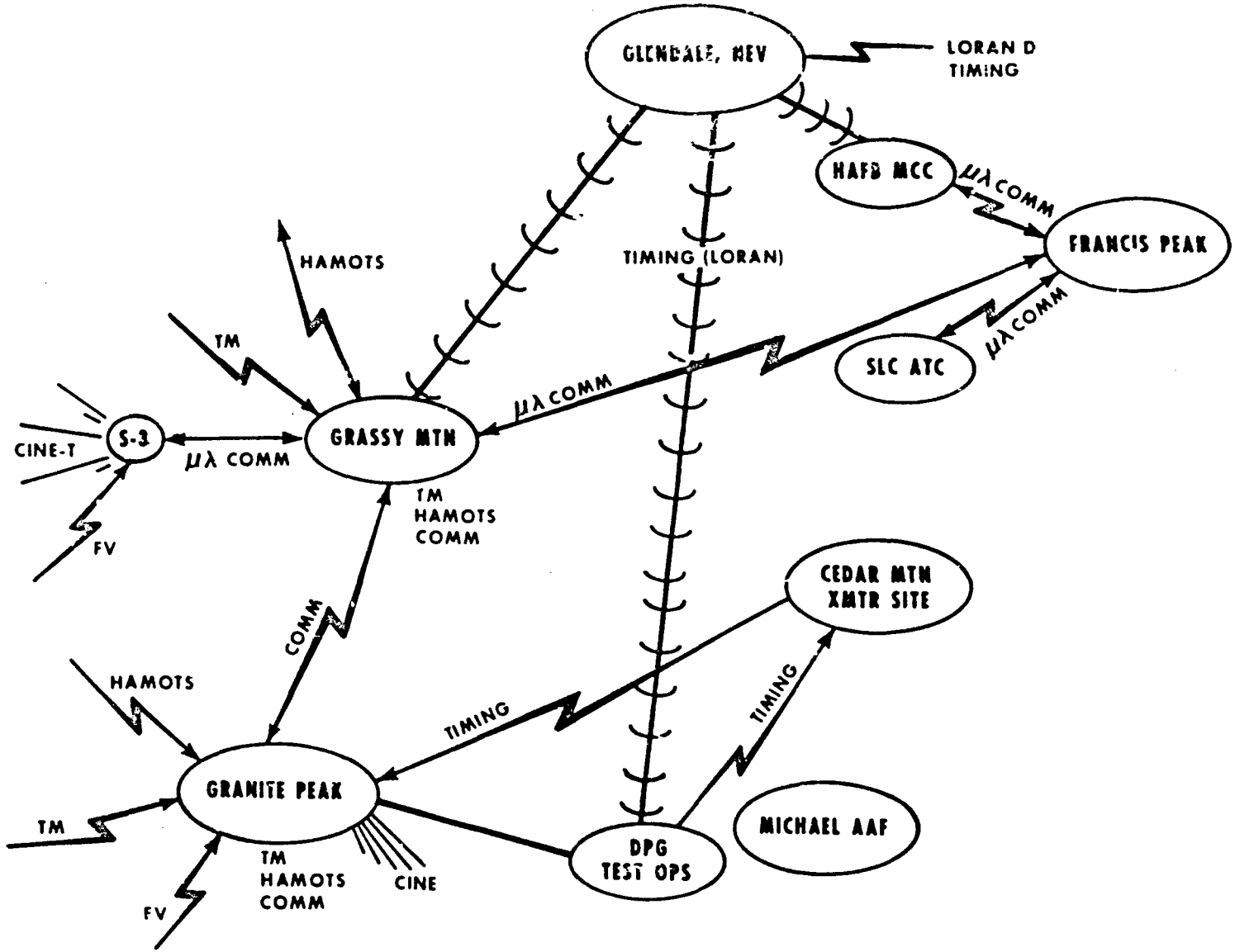

Figure 2. H/W/D Drone/RPV Range Instrumentation Equipment Sites

addition, interface requirements between these systems and the other systems cited above are also defined.

2. POSITION LOCATION/DISPLAY SYSTEM SPECIFICATION

The top equipment specification is the Position Location/ Display System specification. This specification establishes functional performance, design and test requirements for HAMOTS (High Accuracy Multiple Object Tracking System) flight test range instrumentation. The HAMOTS is based upon the General Dynamics RMS-II System. As a matter of fact, it is basically two RMS-II systems with C-stations at Granite Peak and Grassy Mountain. The HAMOTS C-stations differ from the normal RMS-II C-stations in that the data processors have been removed and the raw data is sent to the mission control center at Hill AFB via the interrange microwave link for central processing. This arrangement saves the cost of data processing at the C-stations but increases the data transmission capacity required to 200 KBPS as compared to a required 9 KBPS with processing at the C-stations. (The interrange microwave link is not a consideration of this set of specifications but is included in an AFLC/AFSC CEIP programming action.)

The HAMOTS configuration specification consists of two principal subsystems, a radio TSPI measuring system and a display system for range/mission control. Central to the HAMOTS configuration is a data acquisition processor and controller (DAPAC) and associated software. The desired HAMOTS arrangement per this specification is shown in Figure 3.

The specification defines required features of the HAMOTS. These features are:

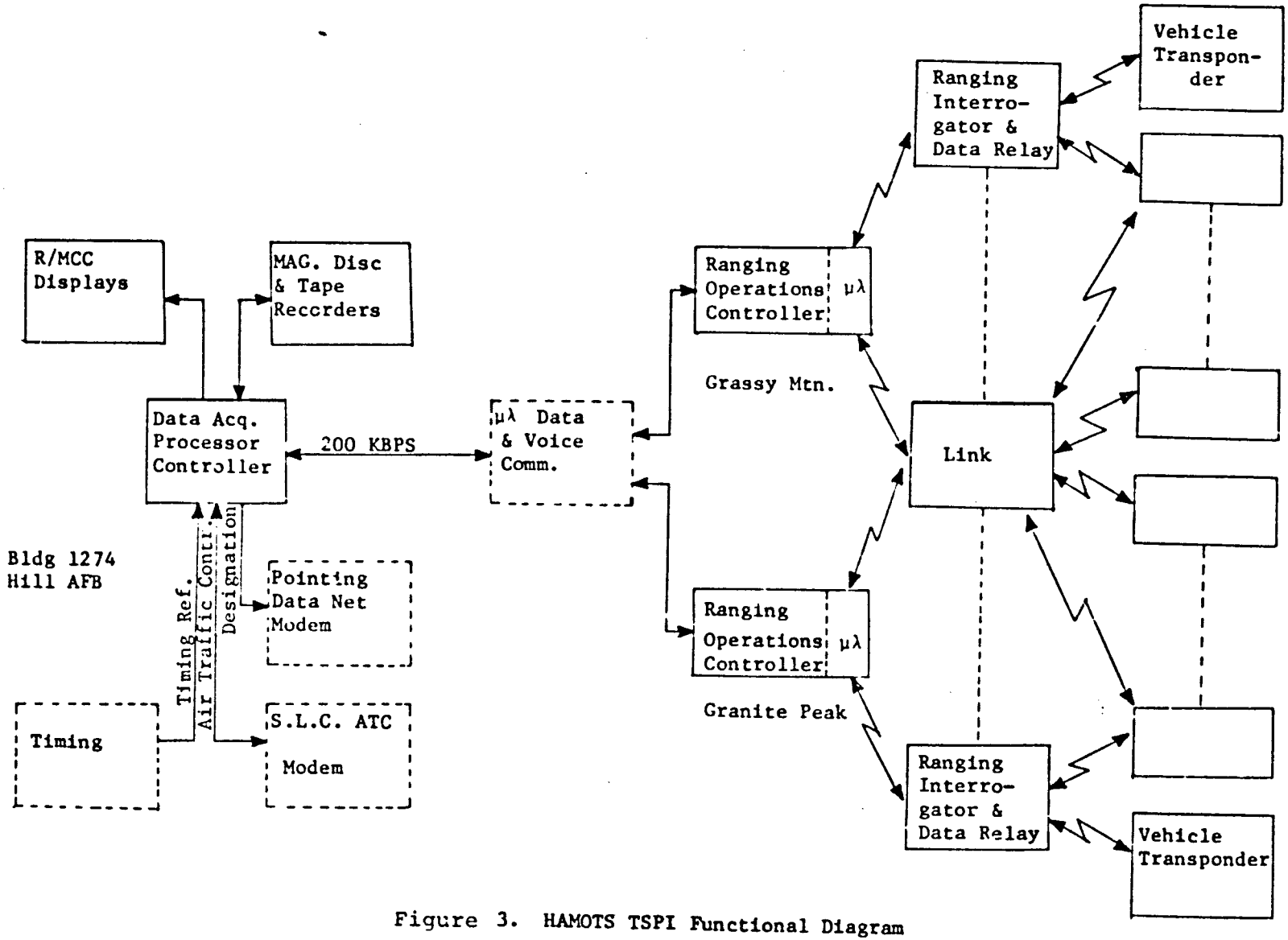

Figure 3. HAMOTS TSPI Functional Diagram

1. Position measuring radio links shall have provisions for sending data/messages to and from test vehicles.

2. Vehicle borne equipment shall be of a size and weight to be readily mounted internally in the vehicles.

3. Ground equipment and automatic processing hardware will be designed to permit reconfiguration and/or extension of the TSPI region on a mission-to-mission basis. HAMOTS hardware/software shall include self survey provisions.

4. HAMOTS shall be compatible with augmentation of TSPI data through use of airborne parameter measurement equipment (e.g., use of an RMS/SCORE type pod).

The system is to have a capability of simultaneously tracking twenty airborne test vehicles, sixteen airborne support vehicles, and four ground vehicles. Tracking shall be at a repetition rate of not less than four times per second for airborne vehicles and not less than one time per three seconds for ground vehicles. Only transponder equipped vehicles can be tracked. If weapons (e.g., missiles, bombs) are to be tracked, they must also be equipped with transponders. There is no provision for utilizing or displaying track data from the two range instrumentation radars on the range (e.g., RIR-777 and MPS-19).

The real-time TSPI accuracy of the HAMOTS given in Table 5 is substantially worse than the COR specification (Table 2). However, post mission accuracy is comparable to the COR specification. It may be anticipated from this fact that if the vehicle borne equipment and the DAPAC real-time software were upgraded to the equivalent of an RMS/SCORE, the HAMOTS would meet the COR accuracy specification. Also, since these accuracy specifications apply to the entire range area, it may be anticipated that accuracy within certain parts of the range will be substantially higher. The requirement that HAMOTS ground stations be locatable and expandable will assure that the higher accuracy can be achieved in selected terminal areas.

Table 5

HAMOTS ACCURACY REQUIREMENTS

A. Real-Time TSPI Accuracy

1. Within the Range Complex, x, y, z ($\pm 1\sigma$) = $\pm$200 ft.

2. Area Adjoining Range Complex, x, y, z ($\pm 1\sigma$) = $\pm$400 ft.

B. Post-Flight TSPI Accuracy

1. Within the Range Complex

a. x & y ($\pm 1\sigma$) = $\pm$15 ft.

b. z basic ($\pm 1\sigma$) = $\pm$25 ft. (90,000' to 15,000' MSL)
$\pm$40 ft. (15,000' to 2,000' AGL)
$\pm$150 ft. (below 2,000' AGL)

c. z augmented ($\pm 1\sigma$) = $\pm$20 ft.

2. Area Adjoining Range Complex (Above 15 Kft MSL)

a. x & y ($\pm 1\sigma$) = $\pm$30 ft.

b. z ($\pm 1\sigma$) = $\pm$200 ft.

R/MCC displays and display interfaces are shown in Figure 4. In addition to the required displays, the system has the capability of handling up to three remote graphic displays in physically separated locations. The displays required for each of the three control centers at Hill AFB are tabulated in Table 6. The consoles are provided with Key Select Panels (KSP). The KSP shall each have a 36 button/switch selection for communications functions such as voice intercom, remote radio keying, telephone, and visual and audible signalling. The mission control functions to be performed by this system are limited by comparison with COR requirements. This is particularly evident in areas of air traffic control and range safety. There are no provisions for tracking of aircraft (military and civil) that are not equipped with HAMOTS transponders, or for direct input of track data from Salt Lake City Air Traffic Control (ATC) to the computer. A 4800 BAUD SLC/ATC data modem is specified, but the software specification provides no means of inputting this data other than by manual input and update by an operator. However, the mission control limitations of this system do not represent an interface problem for COR since command and control for COR related missions will be conducted from COR Central at Nellis.

3. POINTING DATA NETWORK SPECIFICATION

The second specification in the series is the Pointing Data Network specification. The Pointing Data Network receives digital pointing data from the DAPAC on voice grade channels and generates designation data of the cinetheodolites, cinesextants, and the telemetry antennas. The data format and technical characteristics shall be compatible with the existing VATS equipment through which the RIR-777 radar now points the optical sensors.

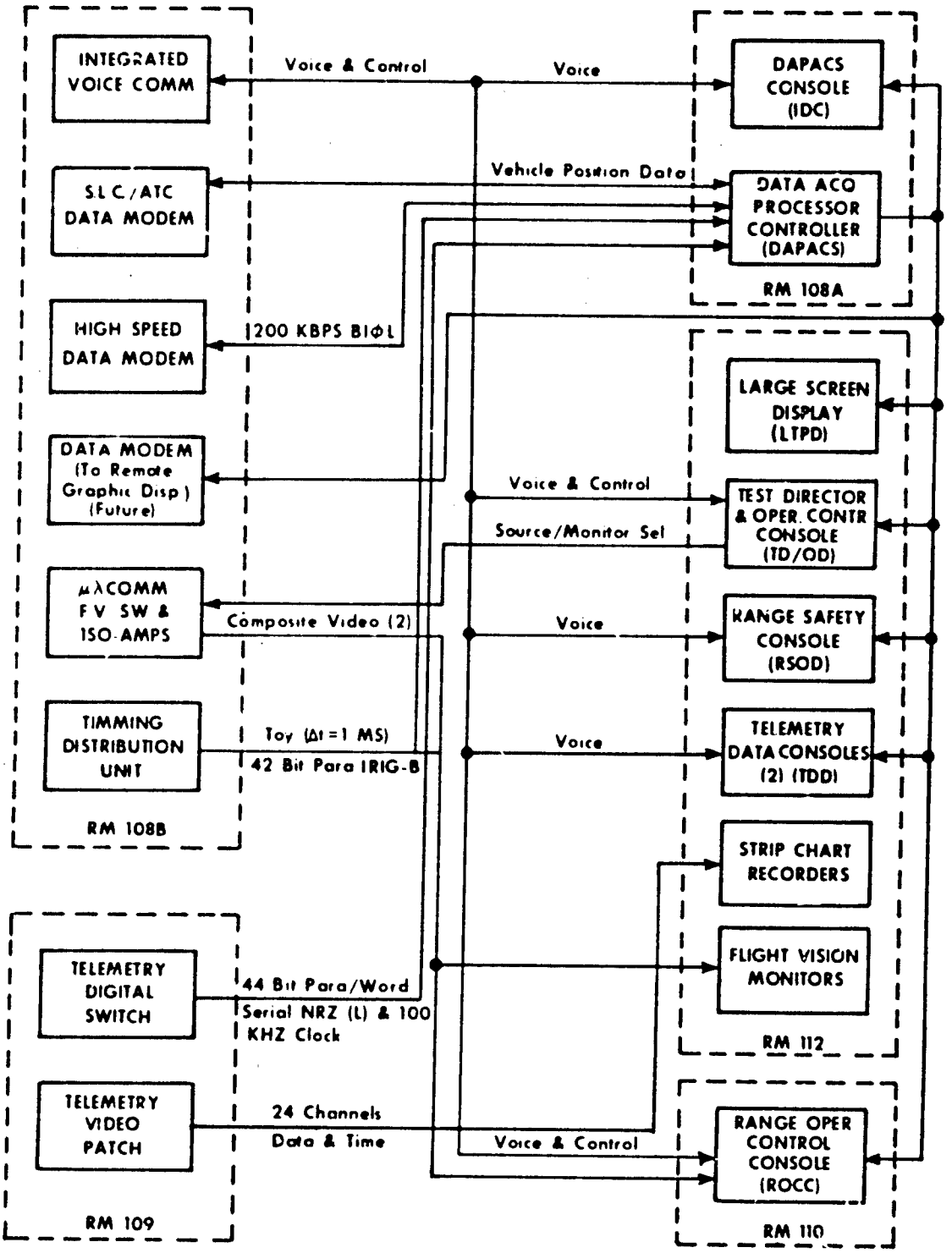

Figure 4. Display Interfaces

Table 6

R/MCC DISPLAY COMPLEMENT

A. Mission Control Center (MCC)

1. Large-screen, tri-color projection display
2. Test Director's/Operator's Graphic Display with hard copy device
3. Range Safety Officer's Graphic Display
4. Two real-time telemetry data alphanumeric displays
5. Two FLITEVISION Monitors
6. Strip Chart Recorders

B. Range Operations Control Center (ROCC)

1. Range Operations Alphanumeric Display with Hard Copy Device
2. Two FLITEVISION Monitors

C. Data Acquisition Processor and Controller (DAPAC) Center

1. Interactive Display Console

The basic function of this equipment is to substitute the HAMOTS for the existing tracking radars as a designation source for these equipments. The pointing data is supplied by the DAPAC at Hill AFB at a rate of up to 10 times per second. There are no specifications treating corrections for transmission delay or dynamic lag. It is questionable that the pointing system, as specified, could adequately designate the optical systems to high performance airborne vehicles. However, if this system is constructed and its performance goals are achieved prior to inauguration of Mid-Term COR, it may be expected that the system will adequately serve COR objectives. If the system performance is inadequate to meet COR requirements, a performance level satisfactory for COR can probably be achieved by placing minicomputers at Granite Peak and Grassy Mountain, and supplying these computers with high quality, accurately time-tagged state vectors from the DAPAC at Hill AFB.

4. TIMING SYSTEM SPECIFICATION

The third equipment specification in the set is the Timing Network specification. The general configuration of the timing network closely matches that specified for COR. It is based upon the use of WWV for time of day and LORAN C/D for fine-grain timing. Synchronization to LORAN will be to one microsecond. However, the system will use a crystal oscillator reference rather than the rubidium clock specified for COR. The crystal oscillator will provide a stability of one part in 10^7. The only deficiency of this timing system with respect to that specified for COR is the fact that in the event that LORAN C/D timing signal is lost for an extensive period of time, the crystal controlled oscillator would not meet the long-term drift stability criteria established for COR.

There would be three such master clocks on the range; one at Granite Peak, one at Grassy Mountain, and one at Range/Mission Control Center at Hill AFB. The HAMOTS data is time-tagged by the clock (master clock) at Hill Building 1274.

5. POSITION LOCATION/DISPLAY SOFTWARE SPECIFICATION

The fourth in the series of specifications is the Position Location/Display Systems Software specifications. For purposes of software design, it is assumed that the software will be produced in two parts for operation on two separate computers; one computer devoted to time/position/location and ranging tasks associated with the HAMOTS TSPI equipment, and the other devoted to managing the HAMOTS and telemetry display data, and driving the R/MCC displays. The specified computer programs are organized in four groups or modes of operation. These modes are: real-time mission control mode, systems check-out and diagnostic mode, post-mission data reduction mode, and the range management and scheduling mode. The specified design margin for the software states that central processor utilization shall not exceed 50% in the real-time mission control mode. The real-time software specified is basically special purpose software devoted solely to the Drone/RPV task at hand. It may be expected that this software will effectively fully utilize the computer procured for DAPAC.

6. OTHER

The last two documents in the General Dynamics CDRL package are the Facilities Requirements and the Activation Plan. The Facilities Requirements deals with the management, the manning requirements, the training,

operations and maintenance, and the facilities at Hill/Wendover/Dugway. The Activation Plan deals with the planning, manning and schedule for activation of the specified system.

7. SUMMARY

Under the premise that this system is implemented prior to initiation of Mid-Term COR development in the Hill/Wendover/Dugway area, there is nothing that has been found in these specifications that would represent a major stumbling block to utilization of the system as part of Mid-Term COR in that area. The HAMOTS with its computer displays and software, along with the telemetry system and the pointing data system should be viewed as a single instrumentation system for purposes of Mid-Term COR planning. The Mid-Term COR plan calls for introduction of substantially more instrumentation, threat simulation equipment, etc. into the Hill/Wendover/Dugway complex. The COR planning should also include procurement of a large-scale computer and associated software for integration of these systems. In this plan, the interface between COR and the Drone/RPV instrumentation package should be a computer-to-computer interface. The Drone/RPV flight test system displays in this case would be used solely for independent local testing. For COR missions, the COR computer would format the necessary data for transmission to COR Central at Nellis for display.

REFERENCES

1. Draft DCP-111, Continental Operations Range, April 1974.

2. AFCOR Development Plan 73-1, 14 September 1973.

3. Program Management Plan for the Development and Acquisition of the Proposed Continental Operations Range (COR), 15 May 1974.

4. AFLC Test Range Complex, Hill AF and Wendover AF Ranges and Army Dugway Proving Ground Ranges: Ogden Air Logistics Center, July 1974.

5. Instrumentation Plan for Drone/RPV Testing on the Hill/Wendover/Dugway Ranges: Vols. I and II, AFFTC, 1 April 1974.

6. System Specification for Near-Term Continental Operations Range, SS-COR-1, Volumes 1, 2, 4 and 6, 21 June 1974.